

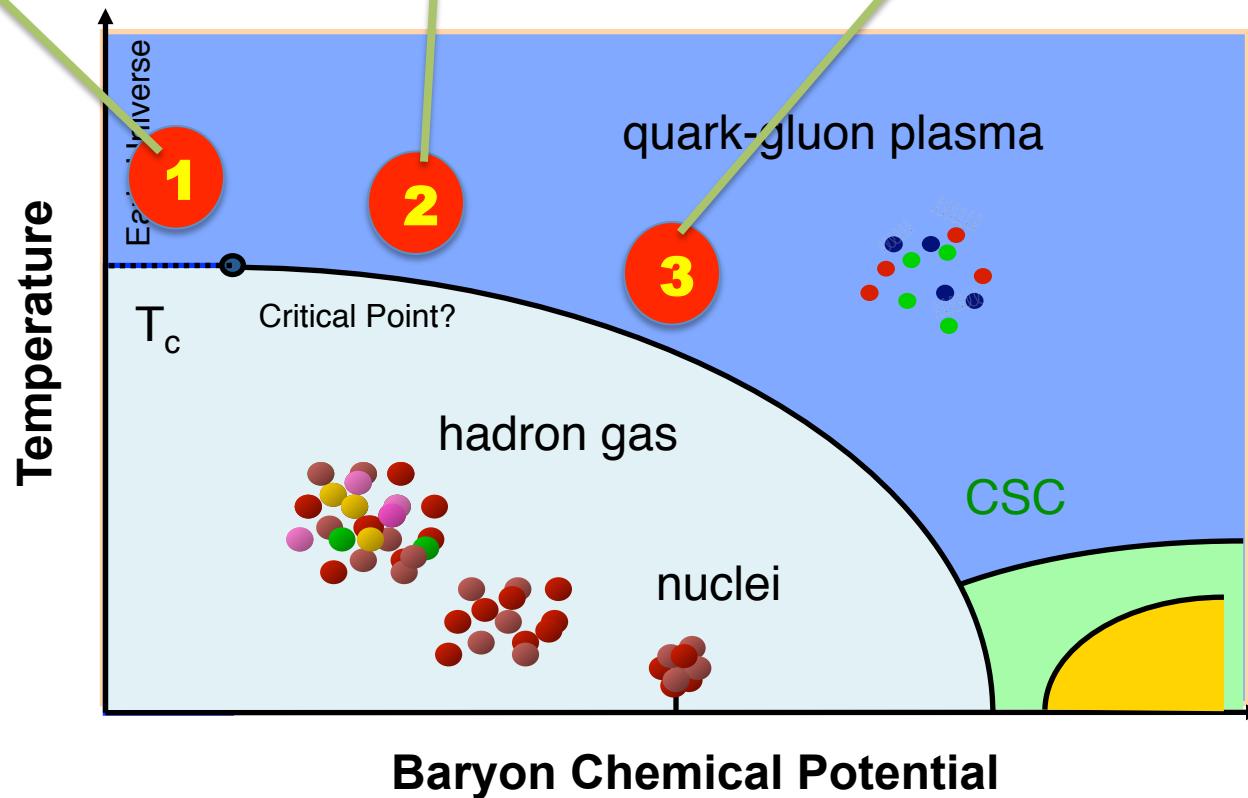
High-Energy Nuclear Collisions

1 Energy Frontier
High-Energy Nuclear Collisions:
LHC, RHIC

2 Density Frontier
RHIC, FAIR

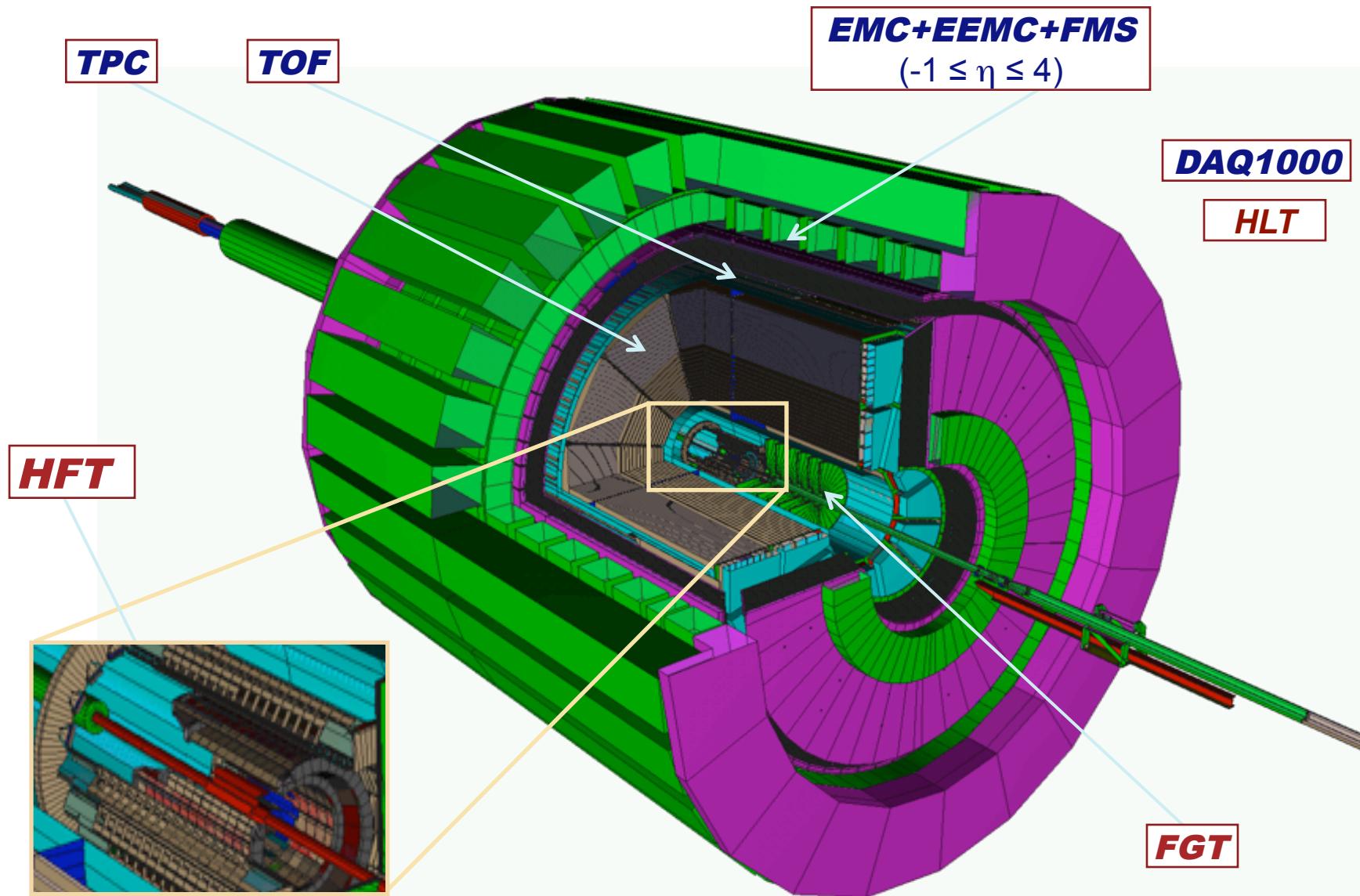
3 Baryon Density
1st order p.b.
FAIR, NICA, CSR

Explore the QCD landscape, structure of the matter with partonic degrees of freedom.





STAR Detectors: *Full 2π particle identification!*





BUR – PAC2009

| Species | Beam | PHENIX | STAR | PAC | Total |
|---------|-------|---------|---------|---------|---------|
| | (GeV) | (weeks) | (weeks) | (weeks) | (weeks) |
| Au+Au | 200 | 10 | 8 | 9 | |
| | 62.4 | | | 4 | |
| | 39 | 10 | 1 | ½ - 1 | |
| | 27 | | 1.5 | ½ - 1 | |
| | 18 | | 2.5 | ½ - 1 | |
| | 11.5 | | 2.75 | 2 | |
| | 7.7 | | 8 | 4 | 22 |
| | | | | | |
| p+p | 500 | 4 | 0 | 3 | 3 |
| | 22.4 | 1 | 0 | | |
| | | | | | 25 |



Physics Programs in Run10

(1) 200, 62.4 GeV:

- *J/ψ & Y programs*
- *Di-lepton program*

(2) 27 – 7.7 GeV:

- *Chemical properties*
- *Collectivity*
- *Fluctuations & Correlations*

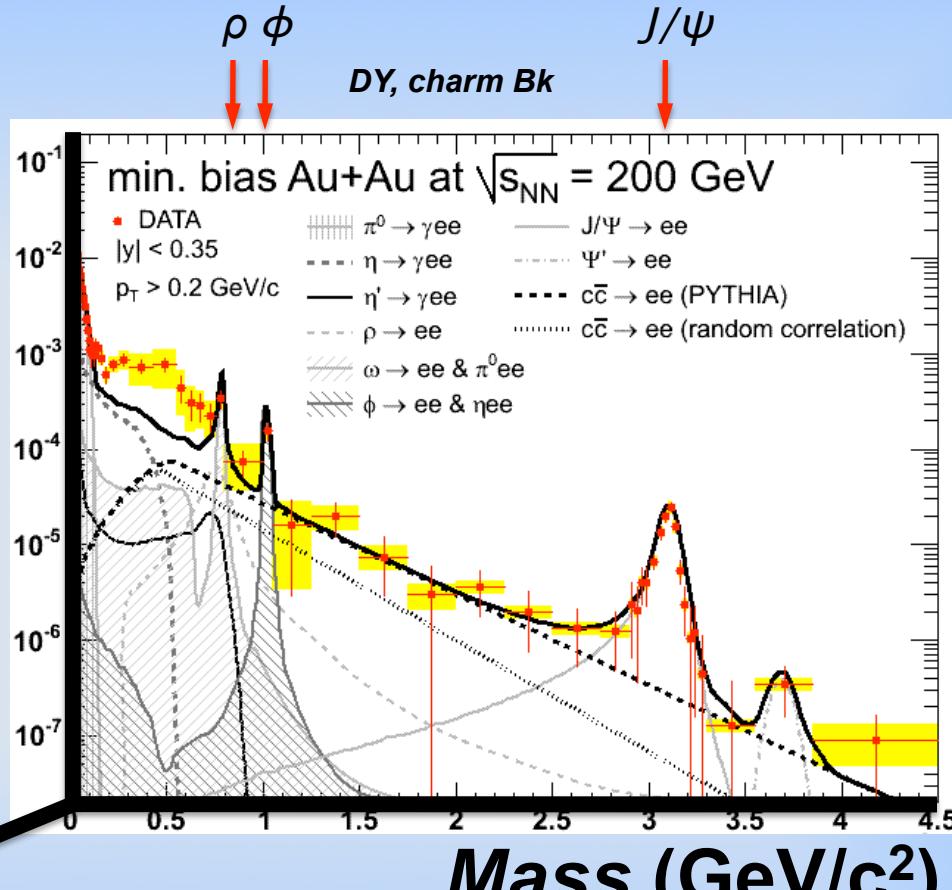
(3) Backgrounds & Triggers

The di-Lepton Program

(1) σ, m

(2) v_2

(3) R_{AA}



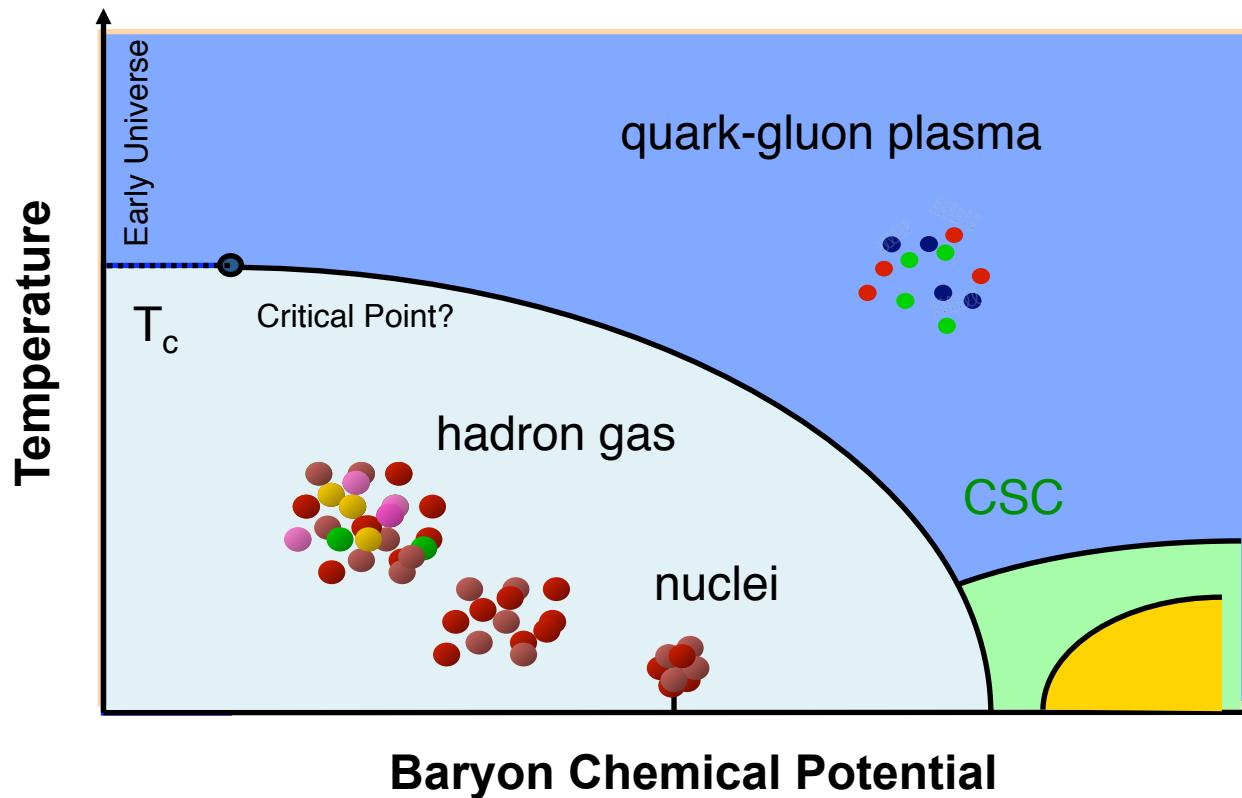
✓ Chiral Symmetry Restoration (may be)

✓ Direct Radiation from The Hot/Dense Medium

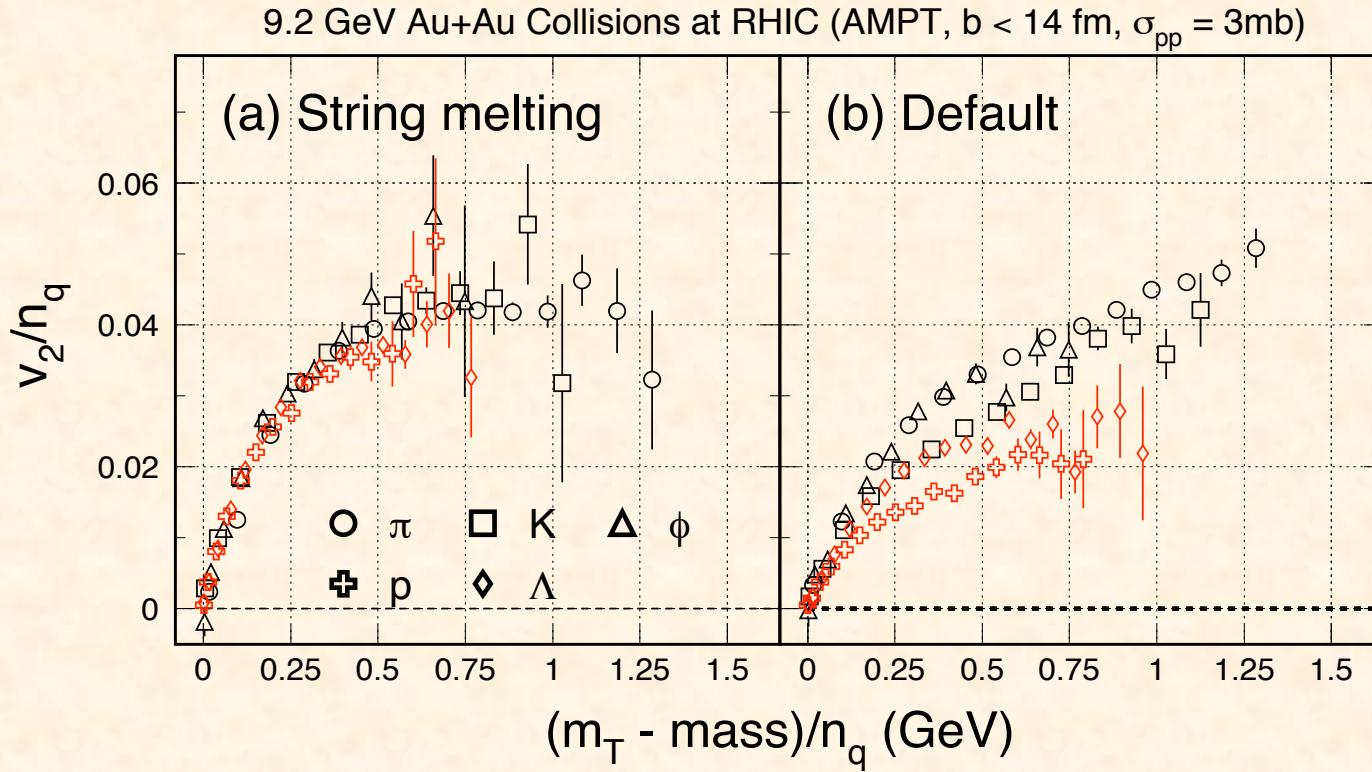
* ToF Crucial for the physics.

S.B.: Fatal Attraction! (A Warning)

High-Energy Nuclear Collisions:
Explore the QCD landscape, structure of the matter with partonic degrees of freedom.



The n_q -scaling in Hadron v_2



- (a) Scaling for all hadrons up to $p_T \geq 3$ GeV/c in case of partonic scatterings and coalescence.
- (b) No scaling in case of hadronic scatterings.



Correlations, Susceptibilities, Kurtosis

$$\delta N = N - \langle N \rangle$$

$$\langle (\delta N)^2 \rangle \approx \xi^2, \quad \langle (\delta N)^3 \rangle \approx \xi^{4.5}$$

$$\langle (\delta N)^4 \rangle - 3\langle (\delta N)^2 \rangle^2 \approx \xi^7$$

$$S = \frac{\langle (\delta N)^3 \rangle}{\langle (\delta N)^2 \rangle^{3/2}}$$

$$K = \frac{\langle (\delta N)^4 \rangle - 3\langle (\delta N)^2 \rangle^2}{\langle (\delta N)^2 \rangle^2} = \frac{\chi_x^4}{\chi_x^2}$$

Higher order correlations are correspond to higher power of the correlation length of the system: **more sensitive to critical phenomena.**

Skewness: Symmetry of the correlation function.

Kurtosis: Peakedness of the correlation function. *Connection to thermodynamics, χ_x .*

S & K obsevables:
total charge, total protons,
net-p, net-Q